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ScienceDirect
Zoologischer Anzeiger 249 (2010) 209–221
Zoologischer Anzeiger
www.elsevier.de/jcz

Ectoparasitism in *Aulacothrips* (Thysanoptera: Heterothripidae) revisited: Host diversity on honeydew-producing Hemiptera and description of a new species

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Received 4 March 2010; received in revised form 10 September 2010; accepted 10 September 2010

Abstract

Until now, *Aulacothrips dictyotus* Hood (Heterothripidae) is the only known thrips to exhibit an ectoparasitic way of life, infesting nymphs and adults of the aetalionid treehopper *Aetalion reticulatum*. However, recent observations in Brazilian Cerrado showed another *Aulacothrips* species infecting several honeydew-producing hemipteran species, mainly membracid treehoppers. Both parasitic species are usually found within a complex multitrophic system, which involves ant–hemipteran mutualism, a host plant and associated insect herbivores. In this paper, we present new data about ectoparasitism in Thysanoptera, describe *Aulacothrips minor* sp. nov. as well as males of *A. dictyotus*, and provide identification keys for adults and larvae of both species. Records of the infected Hemiptera species are given, including their host plants and associated tending-ants. Our results suggest *A. dictyotus* to be a host specific thrips restricted to *A. reticulatum*. In contrast, *A. minor* has a wide range of hosts, attacking 15 hemipteran species, all of them showing a gregarious and myrmecophilous habit. Differences observed in morphology, host use and life history strategies between the *Aulacothrips* species are also discussed.

Keywords: Brazilian Cerrado; Multitrophic interactions; Myrmecophily; Systematics; Treehoppers

1. Introduction

Members of the Order Thysanoptera are called thrips and are known to be relatively opportunistic in their way of life and feeding habits (Mound and Teulon, 1995). The majority of the 5800 described species are phytophagous, nearly 40% are fungivorous and few are facultative or obligate predators on other arthropods (Mound and Marullo, 1996; Mound, 2010). Moreover, some species use curious resources as food, like Lepidoptera exudations (Downey, 1965) and human blood (Williams, 1921).

Despite this great diversity of habits, *Aulacothrips dictyotus* Hood (Heterothripidae) is the only known thrips to exhibit an ectoparasitic life style (Fig. 1a and b). This remarkable way of life contrasts with the flower-living habit of the other heterothripid species (see Del-Claro et al., 1997). *Aulacothripsu dictyotus* was previously recorded by Izzo et al. (2002) feeding on nymphs and adults of *Aetalion reticulatum* L. (Hemiptera: Aetalionidae), a polyphagous

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doi:10.1016/j.jcz.2010.09.002

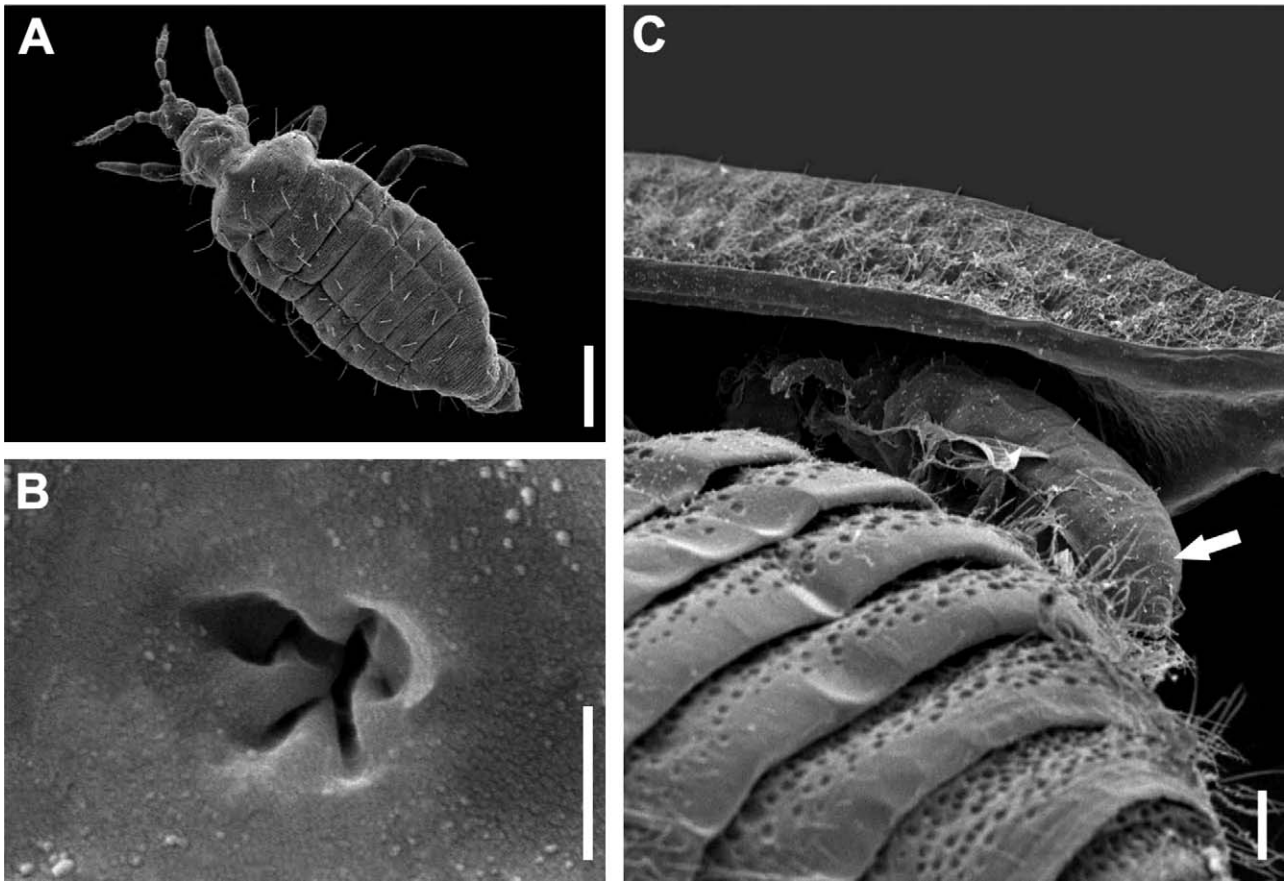

Fig. 1. Ectoparasitic *Aulacothrips* larvae. (a) *A. dictyotus* larva II; (b) damage on *Aetalion reticulatum* abdomen caused by *A. dictyotus* mouth parts; (c) *Aulacothrips minor* sp. nov. larva II (arrow) attached underneath the pronotum of a Membracidae. Scale bars = 200, 1 and 100 μm, respectively.

and gregarious honeydew-producing hemipteran that exhibits symbiotic interactions with ants (Silva et al., 1968; Brown, 1976; Almeida-Neto et al., 2003). Larvae of *A. dictyotus* were found in large numbers under the wings of *A. reticulatum*, and the second larval stage spins a pupal cocoon on the hemipteran body. Although *Aulacothrips* eggs were not recorded, Izzo et al. (2002) suggested that the deformations observed in the hind wings of infested bugs could indicate a scarring of the nymph wing buds by thrips oviposition. The presence of these thrips in *Aetalion* aggregations also affected host behaviour, which became agitated, possibly influencing host biology at several levels.

The external morphology of adult *A. dictyotus* is very distinctive in having, on the abdominal tergites, a dorsal furrow bearing large wing-retaining setae, and enlarged antennal segments III and IV, each one with a highly convoluted sensorium. All these differences in body structure are possibly linked to its parasitic life style (Pinent et al., 2002). These authors also indicated that the association between these two insects was possibly specific, since *A. dictyotus* was not observed infecting any other *Aetalion* species present at the same study site or on the same plant species.

Until now, this was the only species in the genus, and the ectoparasitic behaviour in Thysanoptera was restricted to the association between these two insects. However, recent observations in the Brazilian Cerrado indicated a different *Aulacothrips* species associated with other honeydew-producing hemipteran species (Fig. 1c). Unlike its congener, this new taxon was found infesting a wide range of hemipteran hosts, showing significant differences in life strategies and host utilization. *Aulacothrips* parasitism probably has multiple consequences for Hemiptera hosts and to their interaction with ants. However, this singular relationship remains poorly studied and biological and ecological processes behind it still unknown.

In this paper, we describe a new *Aulacothrips* species and the as yet unrecorded *A. dictyotus* male. Identification keys for adults and larvae are also provided. Auchenorrhyncha species that constitute true hosts for these thrips were recorded, including their host plants and associated tending-ants when infected.